



GEOTHERMAL EXPLORATION, MCGREGOR RANGE, NEW MEXICO

GEOTHERMAL ENERGY

TECHNOLOGY AND INFRASTRUCTURE OPPORTUNITIES

For:
**NM LEGISLATURE INTERIM
SCIENCE, TECHNOLOGY, AND
TELECOMMUNICATIONS COMMITTEE**
17 October, 2013

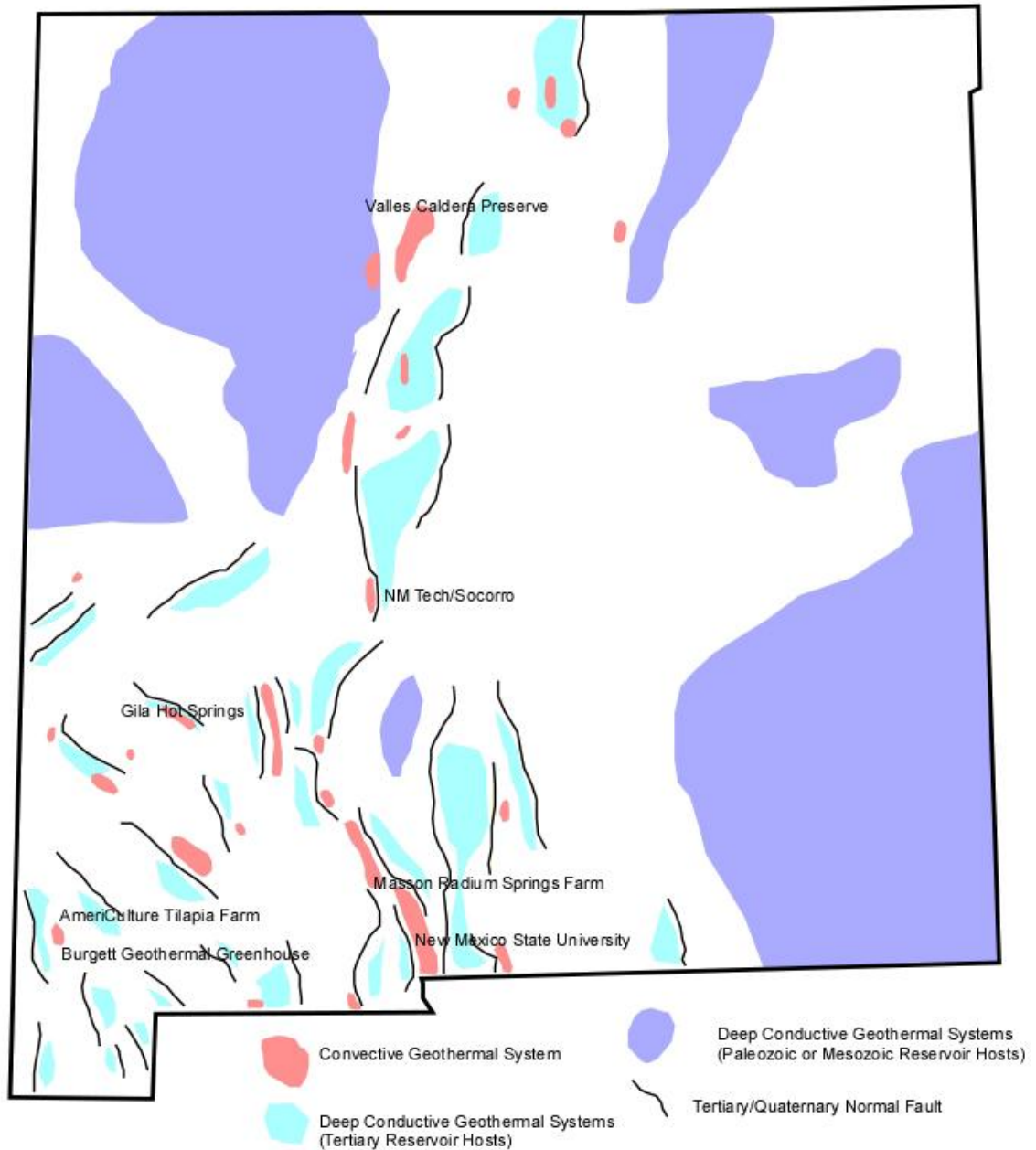
James Witcher
Las Cruces

NM GEOTHERMAL RESOURCE BASE

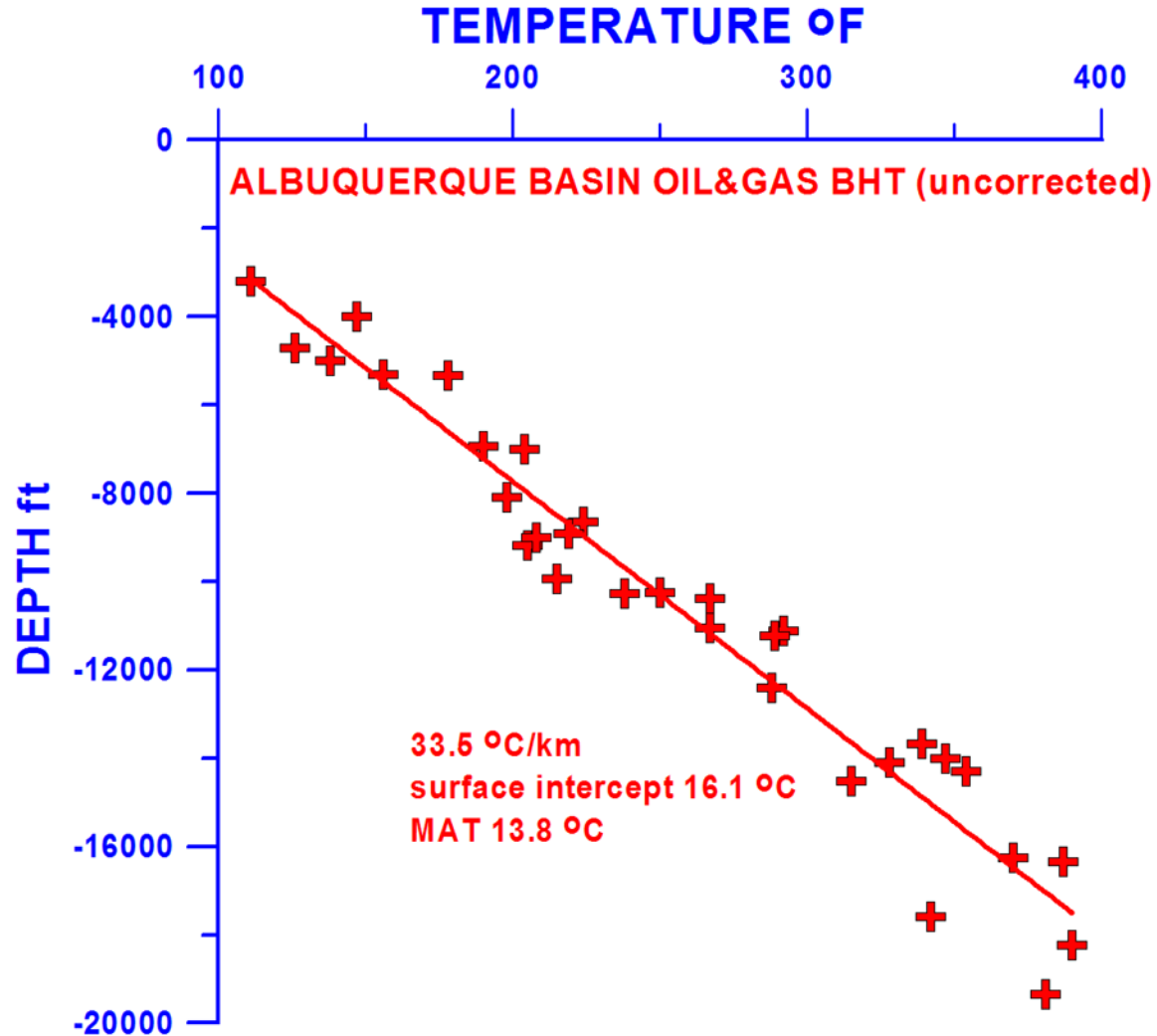
Red
Convective
Systems

Light Blue
Deep Conductive
Systems in Tertiary
Basins

Dark Blue
Deep Conductive
Systems in
Paleozoic and
Mesozoic Basins

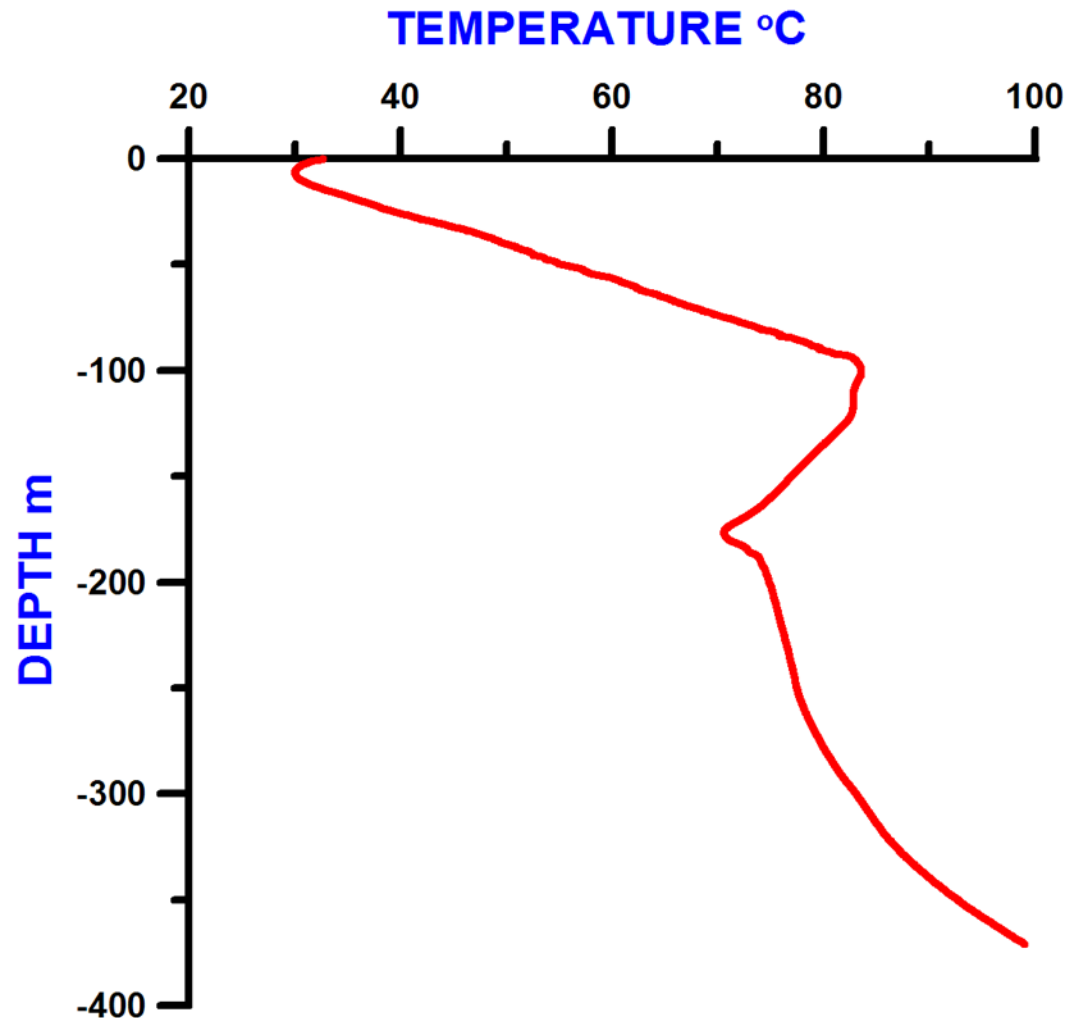


ALBUQUERQUE BASIN CONDUCTIVE GEOTHERMAL



RINCON CONVECTIVE GEOTHERMAL

- Annual temperature wave near surface
- Conductive gradient above water table or geothermal system
- Temperature “rollover” in outflow plume



COMPARISON OF CONDUCTIVE AND CONVECTIVE SYSTEMS

CONDUCTIVE

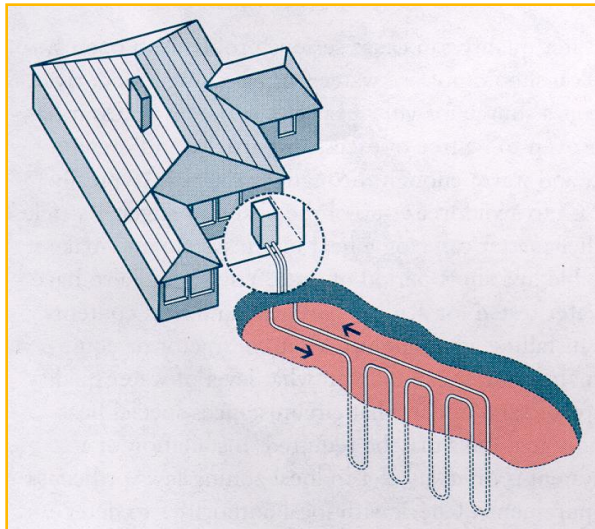
- Very deep reservoirs
- Higher cost and risk
- Very large reservoirs
- Suitable for large-scale power and desalination
- Greater salinity
- Most applicable for brine disposal
- Stratigraphic reservoir

CONVECTIVE

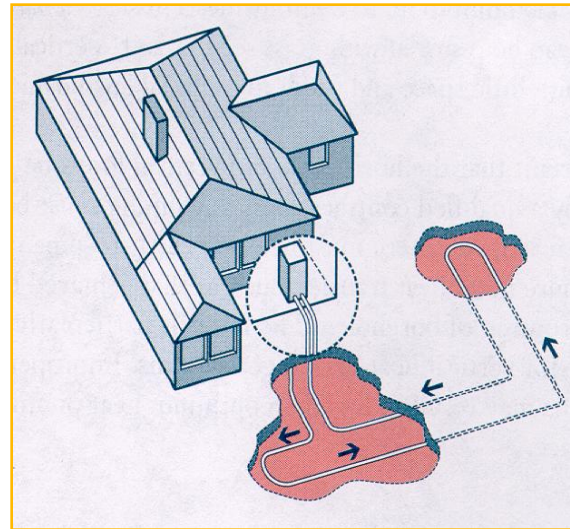
- Comparatively shallow and smaller reservoirs
- Lower cost and risk
- Much smaller reservoirs
- Suitable for direct-use and small-scale power.
- Brackish water most common
- Structural reservoir

APPLICATION CATEGORIES

- ELECTRICAL POWER
- DIRECT-USE
- GROUND-COUPLED HEAT PUMP

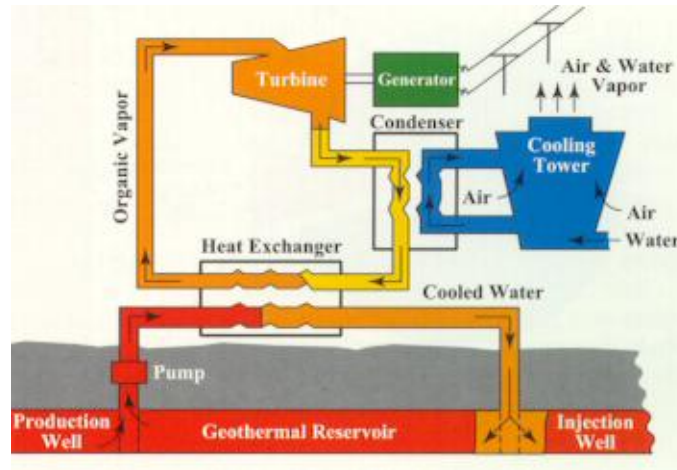


USDOE



USDOE

BINARY-CYCLE POWER



USDOE



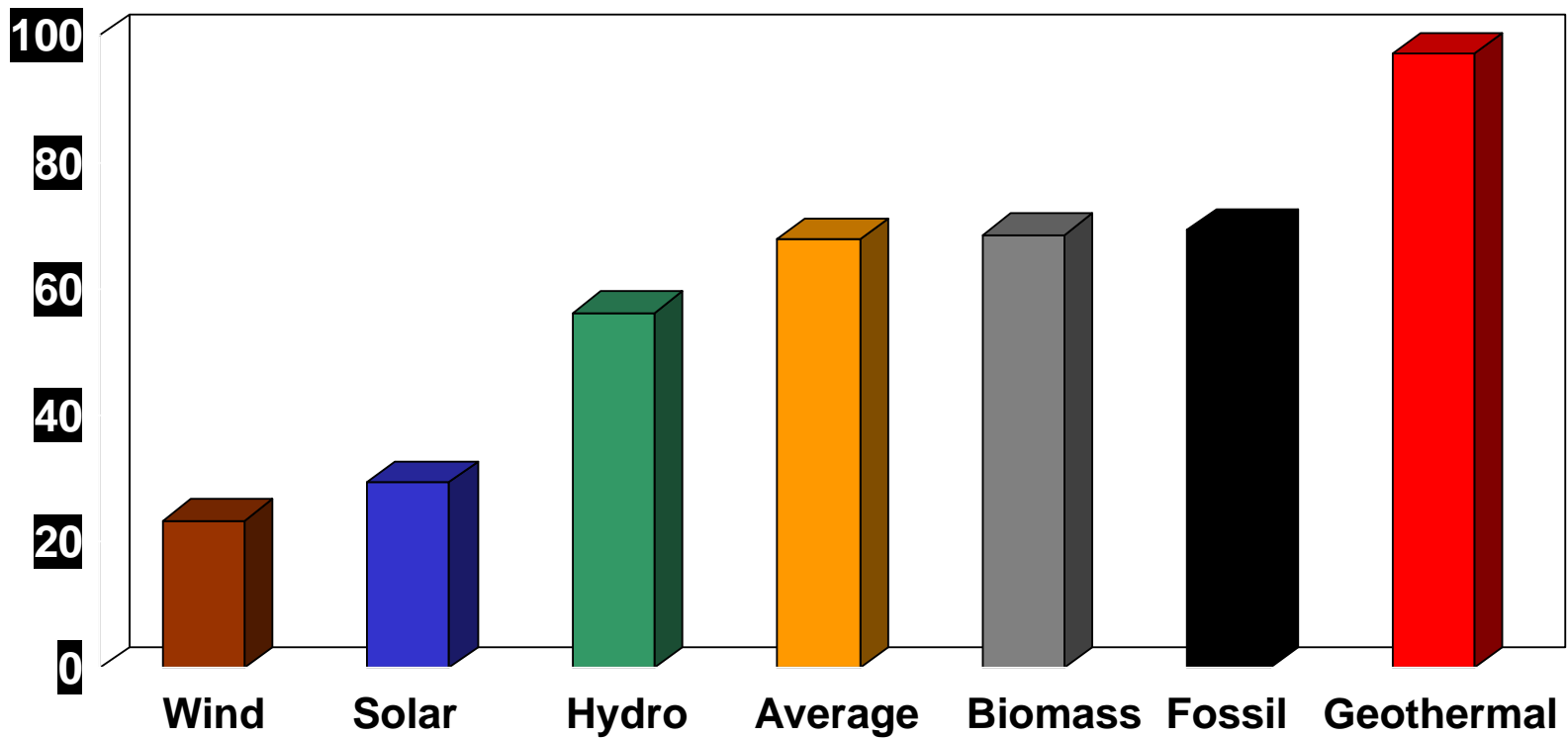
Soda Lake, Nevada, 26.1 MWe Binary Power Plant

Witcher



Witcher

CAPACITY FACTORS



DIRECT-USE GEOTHERMAL

Masson Geothermal Greenhouse, Radium Springs, New Mexico



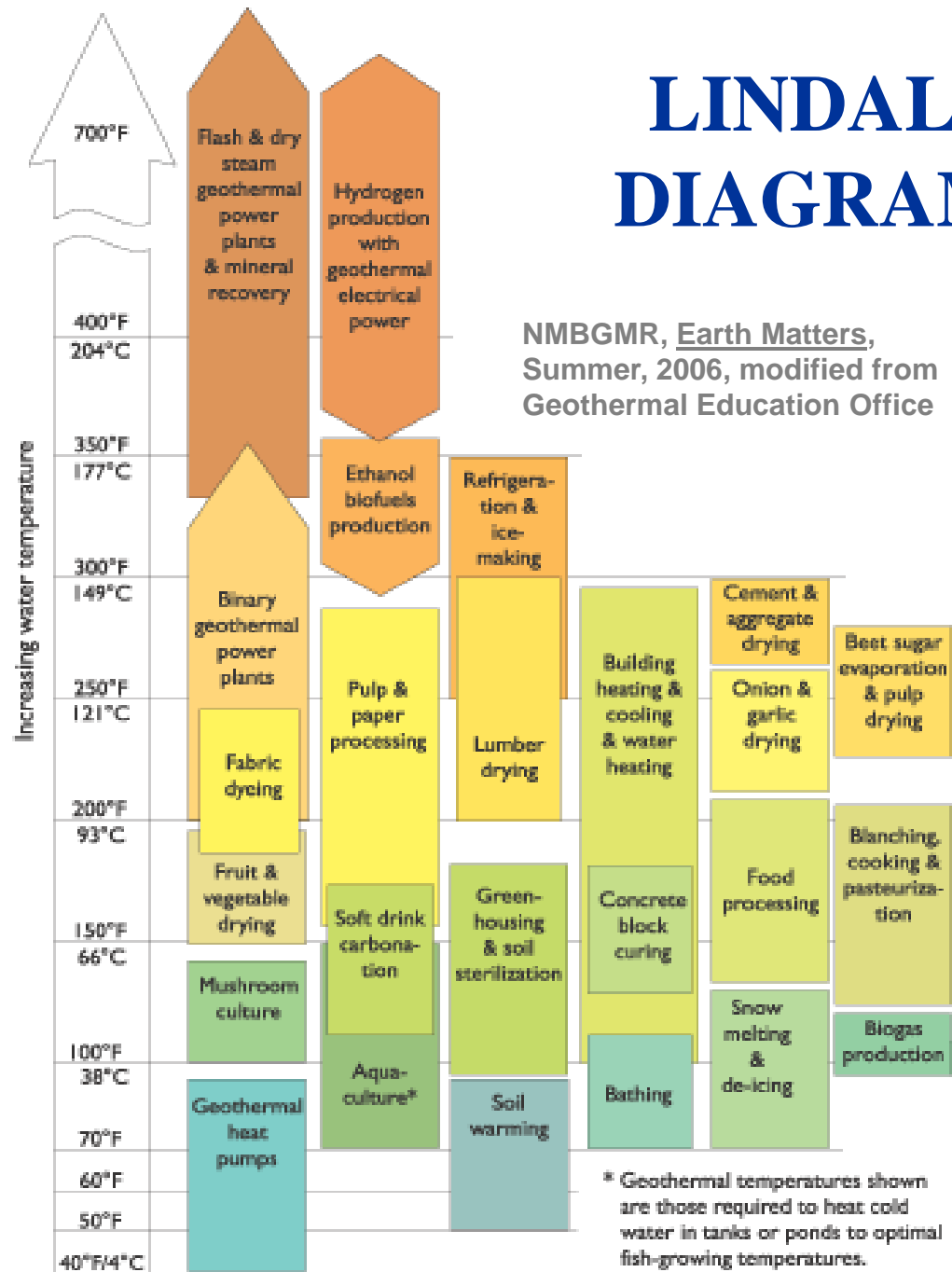
Williamson, NREL

LINDAL DIAGRAM

NMBGMR, Earth Matters,
Summer, 2006, modified from
Geothermal Education Office

OTHER USES ?

- ✓ Desalination
- ✓ Copper/Gold
- ✓ Oil and Gas
- ✓ Biofuels



GEOHERMAL GREENHOUSE HEATING

Photo on cover of journal GEOTHERMICS

- **CENTRAL HOT WATER SYSTEM**
- **GEOHERMAL WELLS AND HEAT EXCHANGERS REPLACE CONVENTIONAL FOSSIL FUEL BOILER**



Williamson, NREL

Masson Geothermal Greenhouse, Radium Springs, New Mexico

GEOHERMAL AQUACULTURE

- **CONTROL CONSTANT TEMPERATURE FOR OPTIMAL GROWTH** (enhanced growth rate)
- **GROWING MARKET POTENTIAL AS NATURAL FISHERIES ARE STRESSED**
- **MANY POTENTIAL SPECIES**
Shrimp, Lobster, Eels, Tilapia, Stripped Bass, Oysters, Algae, etc.



Tilapia

AmeriCulture

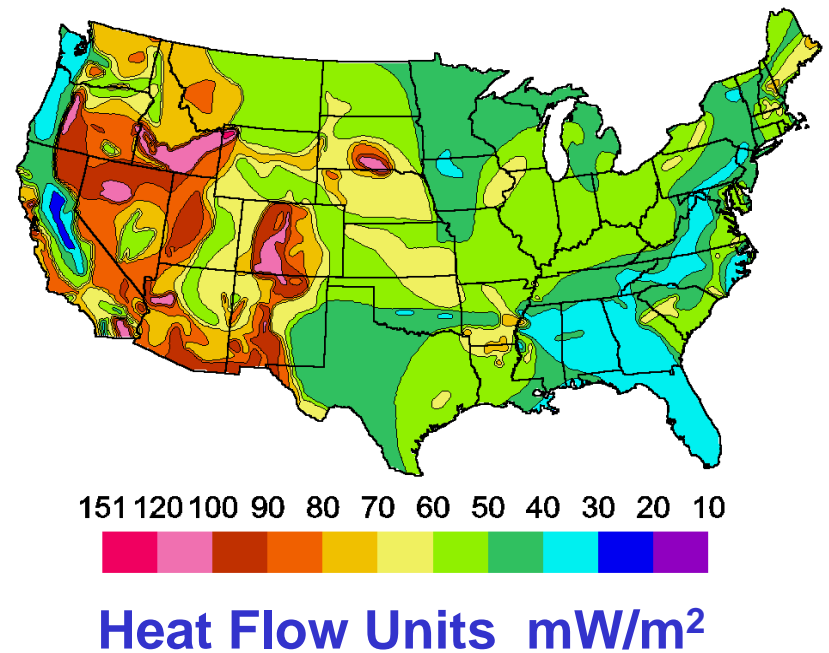
AmeriCulture Tilapia Farm
Animas Valley, New Mexico



AmeriCulture

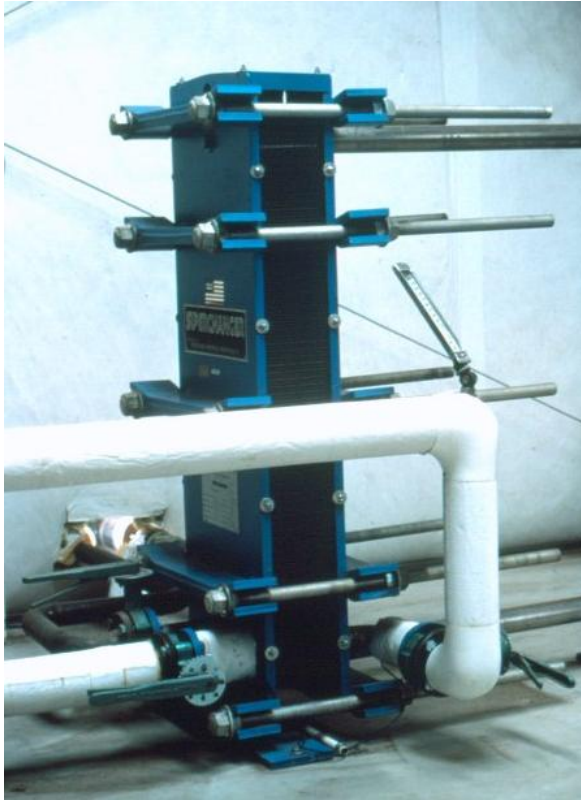
GEOHERMAL DESALINATION

- High Capacity Factor
- Electrical power for pumps and possibly RO units
- Source of thermal energy for process heat in distillation or other desalination technology
- Saline water source
- Process brine sink via injection into reservoir

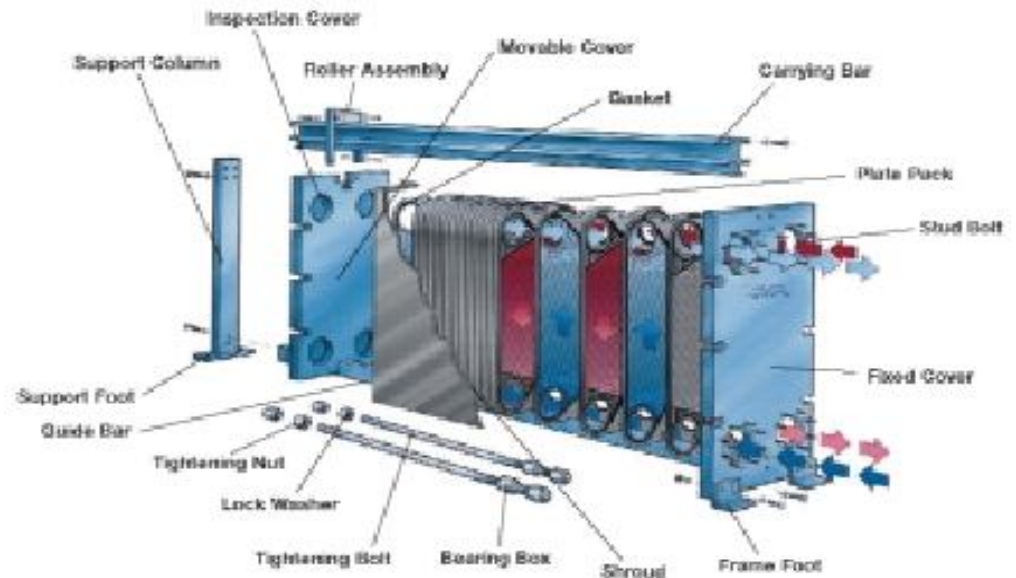


HEAT EXCHANGERS

- Prevent scaling and corrosion
- Isolate geothermal fluids from heating equipment and environment
- Plate and frame heat exchangers are very efficient



NMSU



GEOHERMAL POWER VERSUS GREENHOUSE DIRECT -USE

POWER - Lightning Dock

- \$0.10 kW/hr cost
- 1 or 3 employees
- 8,760 hrs/yr
- \$876,000 per MW/yr gross receipts
- No energy savings compared to natural gas or coal

GREENHOUSE - Radium Springs

- Annual sales \$950,000 to \$625,000 per acre
- 8 employees per acre
- \$46,200/yr energy savings per acre in southern New Mexico (\$12.50 MMBtu commercial natural gas w/boiler loss)
- 4,200 MMBtu/yr at \$1.50/MMBtu



Masson Geothermal Greenhouse, Radium Springs, New Mexico

Williamson, NREL

A GEOTHERMAL PROJECT

- PERMITTING
- RESOURCE OWNERSHIP
- WATER RIGHTS
- ENGINEERING FEASIBILITY
- BUSINESS AND MARKETING PLAN
- FINANCING
- RESOURCE ASSESSMENT AND RESERVOIR CONFIRMATION
- PRODUCTION/INJECTION WELLS
- RESOURCE MANAGEMENT PLAN
- ENVIRONMENT AND PUBLIC RELATIONS

Alligator Aquaculture, Mosca, Colorado



NREL

FINAL THOUGHTS



- Water rights protection of existing water rights where power production of shallow convective resources is done.
- Should definition of geothermal in New Mexico be revisited? (250 F).
- Sustained support for the NM component of the national geothermal database at NM Bureau of Geology, NM Tech.
- Sustained university-based outreach for direct-use geothermal economic development.
- Geothermal direct-use has greater economic impact than power production.